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Strategies That Enhance Voice-On Activities In Middle School School Science

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STRATEGIES THAT ENHANCE VOICE-ON ACTIVITIES IN MIDDLE SCHOOL SCIENCE

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CHAPTER ONE

Introduction

Student participation in *voice-on activities* occurs every day in my classroom; however, in my first year of teaching, this was not the case. To better understand how to engage students in conversations about science and to validate my existing practice, I reviewed literature to answer the following question: *Which strategies enhance voice-on activities in middle school science?*

In 2016, I generated the phrase voice-on activities to categorize the following oral activities: argumentation, collaboration, conversations, discourse, discussions, debates, group talk, student talk, presentations, and many more. In my opinion, requiring students to speak and use scientific language inside the classroom is the most effective way to measure a student's mastery of the material. To improve my students' science literacy, 'the sum of an individual's science knowledge,' and the use of academic language 'the sophisticated language used by professionals,' I infuse a balance of voice-on and voice-off activities into my lessons. While voice-on activities consist of deep academic conversations voice-off activities consist of individual work, pre-assessments, summative assessments, problem solving, and silent reading.

In this chapter I will introduce my struggles as a student afraid to speak in class, my first job and the adjustment I made as a teacher, my current job and the development of voice-on activities, and a conclusion that underscores the significance of the question. To gain a sense of why voice-on activities are important to me as a teacher and as a learner, I will begin by sharing my experience as a high school student who was turned off by silent classrooms.

Experience As A Student

From 1985 to 1988 during my high school electives, I gained exposure to countless hands-on activities. I learned how to type, cook, bake, trace and cut designs out of fabric and wood. In home economics, I made a rice-filled frog and a reversible vest, while in shop class I made a CO_2 car and a squirrel decoy. As I reminisce, I am quite fond of these experiences. However, I cannot recall a time before, during, or after these hands-on activities that we used our voices as tools to learn; instead we remained silent and toiled in isolation.

During my core classes of math, English, science, and social studies there was more toiling—more isolation. Hands-on activities during these classes meant scribbling notes and taking exams. Aligned in straight predictable rows, my classmates and I sat quietly in desks crafted from wood and metal. We never carried on conversations about the topic or compared notes. Our teachers did all the talking—their questions an outright interrogation—our answers a defense. Unprepared and unconfident, whenever I was interrogated, I froze and babbled, "Ah…um…duh." I lacked the vocabulary necessary to articulate my thoughts. From these shameful experiences, I developed a fear of speaking that still lingers today. Moreover, my poor performance on exams left me with feelings of academic inferiority. Needless to say, I hated school.

Then, in the spring of 1988 during my senior year of high school, my opinion of school and my academic ability changed when on one Friday, my English teacher announced, “Let’s Play Jeopardy.” On a chalkboard, she drew columns and rows with yellow chalk. At the top of each column she placed categories that aligned with the weekly readings. When the game started, I blurted the correct responses well before the other students. Category after category I cleared the board and won the game. Suddenly, I went from thoughts of academic inferiority to discovering I had value. I recall how good winning and learning made me feel. For the first time in my academic career I saw the teacher as an ally rather than a villain. Being able to demonstrate my knowledge through gameplay had a lasting effect on me. I remember thinking that if I ever became desperate enough to become a teacher, I too would use games to inspire my students.

First Teaching Job

In 2014, some twenty-five years after graduating high school, desperation festered. Unsatisfied with a lengthy resume of unfulfilling careers, I secured my teaching license and accepted a part-time position teaching biology at a rural Midwest high school. I knew if I planned to accomplish anything meaningful in my life this was it—I was going to reinvent school—students were going to speak and play games.

Leading up to that first day on the job, I envisioned rich oral exchanges with my students—me seeking answers—students begging to respond. At home, I spent hours reviewing the content for genetics. To improve my fluency and overcome my weakness as a speaker, I rehearsed my lecture several times. I concentrated on concise scientific language and strove to eliminate word fillers like *um* and *you know*—I wanted to sound professional—I wanted to sound smart.

However, when I entered the classroom and delivered my well-rehearsed lecture, the students sat glossy-eyed and befuddled. When I made eye-contact and asked open-ended questions, students trapped in the first two rows feigned interest in their feet as overachievers in the way back slouched behind the stiffs in the middle. I was crushed.

Determined to uncover my students' unwillingness to speak, I reflected on my experience as a high school student, and then it occurred to me: I hated answering questions. I often felt I would sound stupid and unprepared. Sure, I wanted a chance to speak in class, but not under the weight of a question. So why should these students feel any different? Here I spent hours learning the material and practicing my lectures so I could sound smart, and then I dumped the information onto my students and attacked them with questions. The students were at a disadvantage. They never had time to familiarize themselves with the material. For many of them, they were hearing the topic for the very first time.

The Change

To level the playing field, I immediately transitioned from a teacher-centered classroom where I dumped knowledge and talked too much, to a student-centered classroom where the students could teach me what they already knew. To initiate our new roles, I held up a food package and read the bold print, "NON-GMO." With a perplexed look, I scanned the room. "What is a GMO?" Slowly, a few hands rose. "Genetically modified organisms," a student answered. "Ah, yes. Can someone give me an example of a genetically modified organism?" More hands rose. The students were hooked and so was I. From that moment, I had no shortage of participants. As my questions grew in complexity so did the students answers and curiosity.

By using questions instead of lectures, I uncovered the secret to engaging students in conversation. Turns out 21^{st} century students are loaded with prior knowledge. Their exposure to books in multiple formats, games, educational television, Internet videos, family, and various technologies, has turned these beings into unrefined versions of walking encyclopedias. Equipped with layers upon layers of information these students had something to say. As I evaluated their responses, I eliminated portions of the upcoming curriculum they already mastered and replaced it with new concepts. Likewise, I modified my lessons for authentic learning opportunities where groups of students read science articles, discussed it amongst their group, shared it with another group, and returned as a whole group to share it with me.

Reading and discussing articles several times gave the students an opportunity to master the material and strengthen their use of the academic language. As students learned from each other, I learned from them. Over time, I became more focused on what the students had to say and less concerned with what I planned to say. It became clear that I no longer had to prepare or rehearse another lecture. Best of all, I pulled content from the articles and reintroduced it during Jeopardy and other games. This introduction to teaching and the transition I made from a teacher-centered to a student-centered classroom set me up for success at my current job.

Current Job

In 2016, I accepted a job teaching middle school science in a large upper Midwest City. To meet the needs of my diverse students and to supplement costly lab activities, I relied heavily on informational texts and explored individual and collaborative activities, which included poster making, storytelling, skits, and non-digital games.

While monitoring my students during these activities, I noticed how quick they could shift from preferred behaviors to meaningless conversations. To quell this nonsense, I often interrupted the class and modeled the correct way to infuse scientific language into their conversations. Although modeling my expectations worked, it consumed a lot of my time and energy. To be more effective I needed an explicit cue to encourage scientific discourse and discourage nonsense. Out of this desire emerged the phrases *voice-on and voice-off activities*.

Voice-On Activities

While voice-on activities promote the use of academic language utilized by scholars and science professionals, voice-off activities eliminate unwanted dialogue and meaningless noise. Now, whenever I announce that an activity is either a voice-on or a voice-off activity, my students understand the expectations. Although both cues proved to be effective ways to manage student behaviors, the importance of *voice-on activities* to promote science literacy and the use of academic language had yet to be revealed.

Revelation

During the third week on the job I gave my students a written assessment. As I observed the classroom, one of my higher-level learners leaned back on his chair and refused to answer any questions. When I inquired about his poor decision, he explained that he could not read or write. I was floored. While monitoring him during voice-on activities his fluency in speech and his ability to summarize the material led me to believe he was fully literate. When I offered to read him the questions he accepted and answered each one correctly. Somehow this student managed to overcome his lack of reading and writing skills by listening and speaking. This revelation helped me understand the importance of voice-on activities and its potential to foster learning.

Although I was convinced voice-on activities improved science literacy and the use of academic language; I had yet to research the legitimacy of my new practice. Then, in October 2017 during a visit to a big city university, I recognized the need for voice-on activities not only at the middle school level, but at all levels of education.

Graduate Students

After debarking our school's sun-faded bus with spray-painted windows (courtesy of the local graffiti artists) the university staff escorted us to an underground laboratory. Standing by, medical students offered us mini-lessons that involved suturing of pig rumps, organ identification, and echocardiogram demonstrations. These medical students were proficient with the tools they used, but failed to explain the processes and procedures with fluency, they fumbled with the language and overused word fillers that included *um* and *you know*. For example: One medical student said, "Um, after you make um you know a suture, then wait until I um show you how to tie it off." From my point of view, the repeated use of word fillers meant the medical student lacked insufficient practice or knowledge.

As I listened further, it occurred to me that the medical students lacked the same oral literacy skills I trained to avoid when I started teaching. This made me wonder; if graduate students at a reputable institution lacked proficiency with academic language, what does it say about their academic experience? Had their teachers and professors much like my former teachers not allowed them sufficient opportunities to rehearse their oral craft? This experience at the local university confirmed the need to continue to use voice-on activities in my classroom.

Conclusion

To validate and improve my practice as a science teacher and increase my students' science literacy and use of academic language, I chose the question: *Which strategies enhance voice-on activities in middle school science?* In this chapter I introduced my struggles as a student afraid to speak in class, my first job and the need to change from a teacher-centered classroom to a student-centered classroom, and my current job and the emergence and importance of voice-on and voice-off activities. In chapter two, I will explore classroom arrangements, science literacy, hands-on activities, inquiry-based learning, formative assessments, and equity before reviewing the literature for prior knowledge, vocabulary acquisition, and non-digital gameplay as strategies to use during voice-on activities. In chapter three, I will introduce the *Voice-On Activities Curriculum Guide For Sixth Grade Science* and explore how it will be implemented in multiple lessons to improve science literacy and the use of academic language inside my classroom. Finally, in chapter four I will review the effectiveness of the curriculum guide supported by the literature review.

CHAPTER TWO

Review of the Literature

Overview of Chapter Two

The goal for this chapter is to better understand the question: *Which strategies enhance voice-on activities in middle school science?* The question is important because it seeks to uncover effective strategies that improve oral learning opportunities for all learners. For the purpose of this chapter, when relevant, in lieu of the term voice-on activities the following terms may be used: collaboration, conversation, dialogue, discourse, discussion, and talk.

The research will examine the effectiveness of traditional versus circular classrooms to enhance voice-one activities, a definition of voice-on activities and how teachers and students benefit from its implementation, and ways to improve science literacy and academic language by making a connection between science inquiry, hands-on activities, and voice-on activities. Finally, the research will explore prior knowledge to build new constructs, vocabulary acquisition to effectively communicate scientific ideas, and non-digital gameplay to motivate students and help answer the question: *Which strategies enhance voice-on activities in middle school science?*

Traditional Classroom

In traditional classrooms, some students have little opportunity to develop their own voice. If students are to maximize learning their voices should be front and center of the learning experience (Juzwick, Borsheim-Black, Caughlan, and Heintz, 2013). However, much like priests, politicians, coaches, and comedians, some teachers prefer center stage where they wield a sense of importance, authority, and control. In traditional settings teachers lecture from the front of the classroom while students sit in desks arranged in columns and rows. Unfortunately, this arrangement denies rich peer-to-peer and peer-to-teacher conversations. While sitting in rows students are denied a face to speak to; there is no eye contact, no facial expressions, and no emotions, just a head of hair. Imagine a staff meeting where teachers sit in rows of tiny desks while the principal drones on and on from the front of the classroom.

To view demonstrations or to be seen or heard from the rear of the classroom students must lean beyond the head and shoulders in front them. This skewed viewpoint inhibits learning while promoting napping, hiding technology, and ducking questions. Essentially, traditional classroom arrangements train students to participate only when they have the right answer (Juzwick et al., 2013).

Circle Classroom

Research across multiple universities compared traditional classroom arrangements that used a variety of configurations aimed to increase engagement. Both students and staff surveyed from these universities suggested the new arrangements improved learning, engagement, creativity, and motivation to attend class (360.steelcase.com, 2014). To facilitate whole group voice-on activities, the circle classroom is among the best designs, leaving student's exposed to face-to-face interaction between the other students and the teacher. According to St. Onge & Eitel (2017), results show that student engagement and participation increases in classrooms that use an all-sitting-circle formation. To ensure positive expectations are being met, teachers should sit with the students during voice-on activities. Monitoring and controlling behaviors within the circle facilitates the development of social and communication skills. School is often the only environment where students can develop speaking, listening, and thinking skills (Dawes & Mercer, 2015).

Define Voice-On Activities

Voice-on activities are classroom actions that emphasize speaking skills. Examples include: collaboration, communication, dialogue, discourse, discussions, group talks, read alouds, turn to your partner and many more. Students' ability to learn and use new language occurs through each of these voice-on activities (Dawes, 2004).

Equity. The use of voice-on activities in the classroom increases equity and literacy achievement for all participants while simultaneously preparing each student for civic engagement and democratic participation (Juzwick et al., 2013). In the classroom, effective voice-on activities allow each student an opportunity to be heard regardless of their intelligence quotient or social status. To further address equity, teachers can facilitate the learning and emotional needs of isolated students by creating peer groups made up of diverse populations. Doing so gives all students access to different viewpoints and ways of thinking.

Educational researchers suggest that voice-on activities support learning and engagement for all students. The act of speaking and listening in small and large group settings can improve literacy for struggling readers. Since the 1960s meta-analysis of empirical studies revealed that several discussion approaches produced increases in the amount of student talk and text comprehension (Murphy, Wilkinson, Soter, Hennessey, and Alexander, 2009). By mimicking real world conversations inside the classroom, teachers can use voice-on activities to develop the next generation of science literate citizens.

Teachers and Voice-on Activities

Voice-on activities are important for the development of scientific concepts and communication confidence. As stated by the National Research Council (2008), "Effective science teaching and learning must include communication and collaboration using both spoken and written representation" (p. 87). Whenever possible, teachers should initiate authentic peer-to-peer or peer-to-teacher interactions by asking open-ended questions. Open-ended questions require students to think deeper about the nature of science. According to Blosser (2000), teachers must ask science students higher-order questions that develop problem solving and decision-making skills.

By implementing voice-on activities the role of the teacher changes from delivering knowledge to monitoring and encouraging knowledge transactions throughout the classroom. According to Miller (2010), "To maximize conversations inside the classroom, first instigate them, encourage listening and active participation, and extend the content and contribution" (p. 27). Essentially, if teachers expect students to be engaged, the teacher must stay engaged.

Teachers play a critical role in facilitating voice-on activities as students learn to enhance their oral and auditory skills while managing their inner voice (Dawes, 2004). Although voice-on activities center on the needs of the student, expectations need to be set and met. To keep students' inner voices on task, teachers should monitor and listen for the use of scientific terms and dialogue. When visiting collaborative groups teachers must model appropriate behavior and verify academic language and listening skills are being used

(Juzwick et al, 2013). If students claim to be finished with an objective, teachers should redirect the students by asking deeper questions and promoting further investigations.

Formative Assessment. Unlike summative assessments that measure student growth using quizzes and exams, formative assessments rely on deep questions, work samples and observations for evidence of understanding. According to Fishman, B., Riconscente, M., Snider, R., Tsai, T., & Plass, J. (2014), "formative assessment is a set of techniques used by teachers to monitor, measure, and support student progress and learning during instruction and is a core practice of successful classrooms" (p. 4). Experienced teachers know by monitoring their students during voice-on activities that they are better able to ascertain a student's mastery of the material. During formative assessments, teachers report using multiple strategies that include observations, looking over a student's shoulder, probing with questions, or requiring students to solve a problem (Fishman, et al., 2014). Using any of these observations teachers can assess their students' science literacy.

Science Literacy

To measure and compare the science literacy and career preparedness of American students to their international peers, every four years since 1995, the Trends in International Mathematics and Science Study (TIMSS), collected data from fourth and eighth grade students (Institution of Education Sciences, n.d). During the 2015 TIMSS, the United States eighth grade science assessment scores improved, yet the scores fell significantly lower than seven other nations (Serino, 2017). American science teachers have a responsibility to ensure their students are science literate and ready to take on the role as global leaders in science and technology.

Science literate students can articulate scientific concepts in written and oral form. According to the National Academy of Science, Engineering, and Medicine (2016), “The phrase ‘science literacy’ was coined as a means of expressing the disposition and knowledge needed to engage with science” (p. 27). Teachers can increase engagement and science literacy by allowing students opportunities to vocalize their thinking. Encouraging repeated use of the scientific language through voice-on activities fosters a deep understanding of our natural world (Gottlieb & Ernst-Slavit, 2014). To gain fluency in writing, oral arguments, and to facilitate understanding of scientific concepts, teachers should guide students in voice-on activities during both hands-on and science inquiry. Used in conjunction with hands-on activities, voice-on activities encourage students to synthesize their experiences into coherent word arrangements.

Hands-On Activities

Building a rubber band car during physics, measuring density in chemistry, or running an osmosis lab in life science are examples of hands-on activities. Activities that engage the hands present kinesthetic learners with opportunities to build curiosity through touch, feel, and manipulating objects. Hands-on experiences in a student-centered classroom motivate students to learn through engagement and run counter to the passive learning encountered in teacher-centered classrooms.

During hands-on learning students construct knowledge while sharing ideas with peers and teachers through voice-on activities. As stated by Bass (2013) in RAFT Resource Area For Teaching, “By using hands-on instruction, educators are fostering the 21st century skills that students need to be successful: critical thinking, communication, collaboration, and creativity” (p.1). Unlike voice-on activities, which can standalone and remain effective, hands-on activities should be paired with the former to increase the value of the learner's experience. It is essential that teachers give students opportunities to collaborate, explore new ideas, and problem solve during these activities. Also, aligning hands-on and voice-on activities promotes social skills through shared ideas and solutions, while simultaneously promoting the use of academic language. The same can be said for pairing inquiry-based science with voice-on activities.

Inquiry-Based Science

Inquiry-based instruction engages students in the procedures of scientific investigations (Haury, 1993). Teacher-to-student and student-to-student collaboration during scientific investigations enhances the use of academic language and fosters deeper understanding. According to the National Science Education Standards (1996),

> Science teaching must involve students in inquiry-oriented investigations in which they interact with their teachers and peers. Students establish connections between their current knowledge of science and the scientific knowledge found in many sources; they apply science content to new questions; they engage in problem solving (p. 20).

To clarify, inquiry-based instruction is not necessarily hands-on in nature but rather it involves multiple activities. According to Stone (2014), "Inquiry-based instruction includes a variety of teaching strategies, such as questioning; focusing on language; and guiding students to make comparisons, analyze, synthesize, and model" (p. 90). Each of the strategies listed contributes to the construction of knowledge when used during voice-on activities. The nature of inquiry-based education supports the constructivist model of learning widely supported by science teachers (Haury, 1993).

Finally, scientific inquiry is a combination of activities, knowledge, and ideas that introduce students to the investigative nature of career scientists (The National Research Council, 2000). Hands-on and inquiry-based instruction in conjunction with voice-on activities not only prepares students for careers in science but also it prepares them to better address issues that affect their communities.

Community and Career Readiness

Career scientists use argumentation to explain processes and procedures with colleagues, in classrooms, at conferences, and testifying in front of Congress. To be persuasive, scientists must articulate their findings with concise language and fluency to gain the support of their peers (Tippett, 2009). To reinforce scientific vocabulary and fluency, teachers should design voice-on activities that duplicate real-world collaborative scenarios between scientists and the public. Engaging students with speaking and writing prompts about science facilitates and prepares students for decision-making that involves the nature of science (UNESCO, 2010).

According to the Common Core State Standards Initiative, 2010 (as cited in Juzwick, 2013),

> To prepare for the rigors of college and career, students should practice voice-on activities through whole class, small groups, and with partners to develop a deep understanding of science content. Not only is it important for students to speak clearly, it is just as important for students to receive and effectively synthesize information from others.

Teachers can prepare the next generation of career ready scientists by challenging their students to speak fluently and convincingly about the nature of science. As Mercer states (as cited in Doig, 1997, p. 6), “The teacher is a discourse guide, whose role in science is to help children become fluent in the educated discourse of science, and thus become part of the wider scientific community."

Issues of serious scientific importance that involve the community can be explored with voice-on activities in a civil manner. Teachers and students need to be open to opinions and beliefs from multiple cultural perspectives. Learning to engage and empathize with diverse students in a classroom setting can better prepare our students for future discussions about issues that affect humankind (Juzwick et al., 2013). If students are to acquire the oral power needed to affect change, teachers need effective strategies to facilitate these outcomes.

Strategies For Voice-On Activities

Although there are likely numerous strategies to promote science literacy and academic language during voice-on activities, for the purpose of this capstone only prior knowledge, vocabulary acquisition, and non-digital gameplay will be addressed.

Prior Knowledge

Eliciting prior knowledge is a principled practice used to connect students' existing knowledge with new knowledge. Prior knowledge is the total combined knowledge a student brings to the learning environment. It includes explicit, tacit, metacognitive, and conceptual knowledge (Dochy and Alexander, 1995). While some students are exposed to rich science concepts at a young age, others may not be as fortunate thereby lacking the necessary foundation of knowledge. The prior knowledge a student brings into the learning environment facilitates the construction of new knowledge (Biemans and Simons, 1996). With this in mind, it is imperative that teachers assess prior knowledge, and address misconceptions before each new lesson to avoid unfavorable outcomes. If preconceptions are not addressed students could fail to understand the content and possibly lose interest

(Campbell, 2008). If this happens, off-task behaviors are inevitable. Worse yet, the lack of prior knowledge can contribute to student frustrations and stifle academic growth (Campbell, 2008).

Teachers can develop meaningful learning opportunities for all students based off of students' prior knowledge (Wessel 2012). Although teachers can elicit this prior knowledge by using videos, pictures, artifacts, and even smells, simply asking open-ended questions can suffice. Asking questions that elicit prior knowledge can enhance comprehension while simultaneously building skills in critical-thinking (Toyin, Tofade, Elsner, and Haines, 2013).

Prior Knowledge And Equity. After assessing prior knowledge, teachers can arrange students into peer groups according to varied strengths. Special considerations should be made to ensure groups are culturally diverse. Each student independent of their culture and ethnicity brings an unmatched perspective and prior knowledge (Wessels, 2012). It is the rich diversity and varied experiences shared during voice-on activities that provide all students an unparalleled access to new ideas, new friendships, and a new world.

Socialization. Granting time for students to share prior knowledge in small or large groups primes the mind for broader discussions about science. Children arrive at school with prior knowledge and language connections that help them communicate and make sense of science (Dawes, 2004). Easing into discussion topics founded on existing knowledge can increase a student's oral confidence and aid in the cultivation and refinement of new and existing language. According to Barnes, 1992; Berk & Winsler, 1995 (as cited by Tippett, 2009, p.17), "Language mediates social interaction and meaning is constructed as learners interpret and reinterpret events through the lens of prior knowledge." The socialization that occurs among students and teachers during voice-on activities can transform prior knowledge into the concrete concepts needed for science literacy. As research suggests, students have ideas and prior knowledge about science that help them make sense of the world (Tweed, 2009). To enhance the quality of students' ideas and prior knowledge, teachers should introduce key scientific vocabulary.

Prior Knowledge And Vocabulary. Introducing science vocabulary while students explore preexisting ideas is an effective way to reinforce and build constructs. It is a student's prior knowledge and experiences that facilitate the learning and recognition of the new vocabulary (Blachowicz & Fisher, 2004). As students share prior knowledge during voice-on activities, teachers can increase or decrease the complexity of the vocabulary as needed. By sharing prior knowledge, students increase their capacity to obtain vocabulary and content knowledge (Blachowicz & Fisher, 2004). Essentially, every time a new word is learned, it will exist as background knowledge for future scientific concepts. According to Marzano (as cited in Campbell, 2008, p.10), "Vocabulary plays a fundamental role in any student's knowledge base. In fact, some research suggests that teaching vocabulary is synonymous with building background knowledge." To better understand how voice-on activities facilitates the building of new knowledge vocabulary acquisition must be explored.

Vocabulary Acquisition

To build and reinforce preexisting concepts, teachers can transition to full-scale voice-on activities that emphasize vocabulary acquisition. Possible examples include: writing and performing a skit about Isaac Newton using the terms inertia, gravity, motion, acceleration, forces, and speed; or writing a song about the rock cycle using the terms igneous, metamorphic, sedimentary, intrusive, and extrusive. The importance of vocabulary acquisition in conjunction with voice-on activities cannot be understated. Scientists use specific terminology to communicate findings and share ideas. For students, the same language is used to make sense of the science and the world around them, (Dawes, 2004). To become fluent with scientific terms students, need multiple opportunities to use and listen to the language.

Listening. During voice-on activities students benefit from practicing science vocabulary and learning how others derive meaning (Dawes, 2004). Students who are uncomfortable speaking in front of others can still learn by listening. According to Kelly, 2007, 2008 (as cited by Juzwick et al., 2013, p.5, 6), analysis suggests that even when students passively engage in voice-on activities, they can benefit from the classroom culture. For some students, listening is the preferred method for acquiring knowledge. Teachers founding a classroom on equity understand that mastering the use of scientific language during voice-on activities involves more than just speaking.

Vocabulary And Equity. Transformative teachers can further promote equity by creating collaborative classrooms where diverse abilities can practice vocabulary. Since some students' lack exposure to rich vocabulary at home, it is important to create vocabulary rich opportunities in the classroom, (McKeown and Beck, 2004). While many students arrive to school having been exposed to academic vocabulary at museums, exhibits, and by educated parents, others arrive with a limited exposure to academic vocabulary; however, to discount this latter group would be unwise. Often times these students come equipped with common sense ideas derived from real hands-on experience working and collaborating alongside family members. They do not need an exhibit to teach them about agriculture; they know agriculture because they have milked the cow, butchered the hog, and plowed the field. In many cases, the hands-on machinery and equipment these students use comes with manuals and its own terminology.

Reading. The rich backgrounds of these students and the material they have read can help shape new knowledge and ideas for others. To take advantage of the existing knowledge and vocabulary from diverse learners, teachers should facilitate peer reading and the sharing of experiences during voice-on activities (Fisher and Frey, 2012). For more challenging material, teachers in middle school science can do read-alouds to introduce and articulate new vocabulary. Also, making time to ask questions and elaborate during read-alouds aids in the construction of conceptual knowledge and vocabulary (Sinatra, Zygouris-Coe, and Dasinger, 2011). After teachers have successfully read out loud, students should read the same passage alone or with a peer. During a meta-analysis of the research, Sinatra, et al. (2011) found, "The relationship between vocabulary knowledge and reading comprehension is an extension of the relationship between receptive vocabulary understanding and listening comprehension," (p.335). Introducing vocabulary before exploring the text increases reading fluency and comprehension. If the learner understands the vocabulary prior to reading, it will be easier to comprehend the meaning when it occurs in print (National Reading Panel, 2000).

Students' ability to comprehend the text relies heavily on their acquired vocabulary. It is imperative that students develop strong vocabularies early in life to avoid poor performance in reading, writing, and other subjects (Sinatra et al., 2011, p.334). To further enhance vocabulary acquisition, teachers can utilize scientific articles that are rife with academic language. Requiring students to highlight scientific vocabulary can be an effective acquisition strategy. Also, asking students to read highlighted vocabulary and sentences out loud during voice-on activities reinforces the vocabulary in the context as it was intended, and gives students an opportunity to hear how they and others use the word. It is through this process of speaking, listening, and reading that improves a student's vocabulary acquisition (Blachowicz and Fisher, 2004).

Speaking. Regardless the strategy, students should be allowed frequent opportunities to speak and listen to the new terms. Too often teachers assign vocabulary terms and ask students to locate the definitions and rehearse them in isolation (Fisher and Frey, 2012). This practice runs counter to the philosophy of voice-on activities. Asking students to learn the terms and definitions in decontextualized situations is an ineffective and insufficient way to rehearse vocabulary (Fisher and Frey, 2012).

To ensure contextual usage, teachers can enforce students' use of key vocabulary during inquiry-based, hands-on, and voice-on activities. Introducing key vocabulary during these experiences can foster vocabulary acquisition and mastery of the content (Carrier, 2011). To experience successful outcomes using voice-on activities, teachers should require students to explain all scientific processes and procedures using the acquired vocabulary. According to Lorenzutti (2016), "To maximize vocabulary development, teachers should intentionally repeat the exposure of new words at least twelve times over one or two weeks in different contexts such as reading and listening texts, spoken dialogues, and games," (p.3). To further enhance vocabulary acquisition through voice-on activities, non-digital gameplay can be an effective way to engage all students while using the same words multiple times.

Gameplay

Motivation. Many students enjoy a good game. Engaging students with science pedagogy games can increase retention and build knowledge (Coil, Ettinger, and Eisen, 2017). Teachers who already use games in their classrooms would agree. In a recent national survey, ninety percent of teachers believe games are effective at motivating students while eighty-nine percent agreed that it reinforces the mastery of content (Fishman, et al., 2014, p.13). Other research suggests that teaching content through gameplay is indeed a productive use of time. As Marzano (2010) states, “On average, using academic games in the classroom is associated with a twenty-percentile point gain in student achievement” (p. 1). Although there is no clear distinction made between digital and non-digital games, this capstone will focus on non-digital games for low-resource classrooms, but use evidence from research that supports all games in general.

Non-digital games. Although 21st century students are experienced with the fast-paced stimuli offered by digital games; these same students often play in isolation. A better way to engage all students and build a collaborative community is to implement non-digital games that often require two or more players. Implementing non-digital games offers students greater opportunities to interact directly with each other and their teachers instead of through the intermediary of a digital device. Another benefit of non-digital games is that they offer teachers in low-resource classrooms a way to include all of their students in fun and learning. Teachers who want to add games to their classrooms, but lack the resources can ask students to create board games using content vocabulary.

Board Games. Used as a formative assessment, board games are a principled way to check for understanding of concepts in a non-invasive way. The mechanics of board games offer teachers a way to observe and analyze student learning (Zagal and Jochen (2006). Allowing students to design their own games forces students to become intimate with the content. Teachers should monitor and guide students during the game-making process to ensure the games they create are effective tools for learning. Games designed with redundant themes and patterns are likely to reinforce content learning (Treher, 2011).

Content. Content-based games used during voice-on activities can improve academic, verbal, and social skills (Sharp, 2012). Although games have long been used to reward good behavior and reinforce content, teachers are discovering ways to introduce new skills through gameplay. Research states that nearly sixty percent of teachers' report using games to introduce new content (Fishman, et al., 2014). It is important however to make a distinction between games used to educate and games used for reward. Games used to educate are content driven and resemble modified versions of Jeopardy, Trivial Pursuit, or Who Wants To Be A Millionaire, whereas games used to reward might resemble tag or pom-pom pull-away. It is important when teachers modify games that the goals are to improve the overall understanding of scientific concepts and student engagement. Well-designed content-specific games serve as tools that encourage students to investigate a deeper understanding of the material than simple memorizing of facts alone (Squire and Jenkins, 2013).

Vocabulary. Done right, games provoke students' learning of content knowledge and use of scientific vocabulary. One of the benefits of modifying games based off of popular game shows with established rules, allows teachers to focus on specific vocabulary and content that fits the needs of their students. As Fisher and Frey (2012) state, "Games allow academic vocabulary to bubble up naturally in conversation" (p.598). Most important, implementing gameplay in the classroom has the potential to inspire reticent or disengaged students to learn new concepts and vocabulary in an effort to win.

Collaboration. Via competition and the desire to win, students often collaborate to learn more, and in some cases, they take on the roles as leader and as teacher. According to

Sharp (2012), “By creating an environment that actively encourages peers to teach and learn from each other, collaborative gameplay offers students who have already mastered the elements a chance to become the teacher and instruct their classmates” (p.45). Peer-to-peer and peer-to-teacher gameplay can breakdown real or perceived boundaries. Collaboration between these groups has the potential to build strong working relationships as players are required to work face-to-face (Treher, 2011). It is through these ongoing interactions that teachers can monitor gameplay while simultaneously checking for learning.

Formative Assessment. Opposite digital games, non-digital games offer students real learning opportunities and teachers authentic opportunities to check for understanding of vocabulary and scientific concepts through verbal responses. According to research, thirty-four percent of teachers use games at least weekly to conduct formative assessments (Fishman, et al., 2014). While formative assessments provide teachers with timely feedback about students’ learning, games provide students with timely feedback about learning.

Engaging Students In Learning. Research suggests that games motivate students to learn, communicate, collaborate, take risks and build self-confidence (Treher, 2011).
In addition, gameplay provides necessary stimuli for a variety of learning styles. Visual, auditory, and tactile learners benefit from exposure to games in the classroom (Sharp, 2012). For instance, games that involve matching can enhance visual skills, games with questions can engage auditory senses, and games that involve game pieces or drawing can influence tactile learners. Although non-digital games may lack the same high-speed attraction that video games do, they emphasize a variety of learning skills. And best of all, whether or not the students know it, they are learning new skills as they play (Rapeepisarn, Wong, Fung, and Depickere, 2006).

Conclusion

The literature review began with a look at traditional versus circular classrooms proving that the latter are better for engaging students in voice-on activities. A discussion about voice-on activities and their importance and interconnectedness to science literacy, science inquiry, and hands-on activities was addressed.

Also, the literature review emphasized the importance of how prior knowledge can be used by teachers to engage students in the conversation, facilitate the building of new constructs, use student responses to modify lesson plans, and use vocabulary to reinforce and create background knowledge. Furthermore, a discussion on vocabulary acquisition addressed how inserting targeted terms into voice-on activities is a principled practice for gaining fluency and improving science literacy, while preparing students for careers in science. Finally, a review of the literature supported gameplay as a well-supported and widely used strategy by teachers to improve content knowledge, and increase the use of vocabulary while engaging all students in peer-to-peer and peer-to-teacher conversations. The research in this chapter helped answer the question: *Which strategies enhance voice-on activities in middle school science?*

In chapter three the variables considered when developing the Voice-On Activities Curriculum Guide For Sixth Grade Science, and the purpose and timeline for implementing the project will be explored.

CHAPTER THREE

Project Description

Introduction

This chapter includes the demographics of the school where the project took place, results of the recent Minnesota Comprehensive Assessment (MCA), a definition of voice-on activities, and the research methods used during the study. In addition, an overview of the *Voice-on Activities Curriculum Guide For Sixth Grade Science* will be addressed, the timeframe it will be completed, and the intended use of the activities and strategies. Also in this chapter an explanation of how the curriculum guide will be shared with the science, technology, engineering, and math (STEM) committee to explore the question: *Which strategies enhance voice-on activities in middle school science?*

School Demographics

The project will take place at a middle school in a large upper Midwest City. Enrolled at the school are 116 students of which 49% are children of color. Males and females equally represent the student population at 50%. Of this population of students, 53% are eligible for free or reduced-price meals. Also, noteworthy is that 20% of these students have Individualized Education Program of which most have been identified as having experienced childhood trauma. The variables listed above are directly linked to achievement and scores during statewide testing.

State Testing

In 2016, the eighth-grade science MCA scores at the school settled near 40% before increasing to 58% for the 2017 school year. The school's eighth grade math also increased to 57%, which is slightly higher than the district passing rate but lower than the state's passing rate of 66%. On the eighth grade English Language Arts exam the school surpassed the district and states passing rate with 67%. The current eighth grade students will take the 2018 Science MCA following the implementation of some of the voice-on activities outlined in the project.

Overview

Definition Of Voice-On Activities. Voice-on activities are classroom actions that emphasize oral development through collaboration, whole class and small group discussions, peer reading, turn to your partner, and many more. Voice-on activities create equitable learning opportunities by engaging all students in the classroom environment. Lyn Dawes is an authority on language use in the classroom. In her article *Talk and learning in classroom science*, Dawes (2004) states, "Children's development of scientific concepts in classrooms is undertaken through structured activity and mediated through oral language" (p. 677). This idea of mediating knowledge through oral language was the inspiration behind the research for creating the Voice-On Activities Curriculum Guide For Sixth Grade Science.

Research And Methods

The qualitative research for the curriculum guide focused on the importance of using the students speaking and listening skills to build new constructs. The research started with the focus on prior knowledge, vocabulary acquisition, and non-digital gameplay to enhance voice-on activities, but grew to address classroom arrangements, hands-on and inquiry-based activities, formative assessments, and equity. The emerging research gleaned from these areas enhanced the project's overall use as a tool for professional development and for the classroom.

Curriculum Guide

The framework used to create the *Voice-On Activities Curriculum Guide For Sixth Grade Science* is based off of the Minnesota Science Standards and frameworks created by the Minnesota STEM Teacher Center and the Minnesota Department Of Education, 2011. The curriculum guide is designed as a tool for classrooms teachers to facilitate their students' use of academic language and to increase their overall science literacy through voice-on activities.

To better prepare students for careers in science, students should learn to use their voice and listen to the language of scientists to truly make sense of the concepts. According to data collected during the 2015 Trends in International Mathematics and Science Study (TIMSS), the United States continues to lag behind seven other nations (Serino, 2017). If the United States plans to remain leaders in science and technology, it is imperative that American students improve their literacy in these disciplines.

Designed with equity in mind the Voice-On Activities Curriculum Guide For Sixth Grade Science allows teachers in low-resource classrooms to substitute costly labs with quality discussions about our natural world. Although the curriculum guide relies heavily on formative assessments, within each unit exists printable pre-assessments and summative assessments for teachers to measure student learning.

Timeline. From March 2018 to May 2018, portions of the curriculum were tested as a review for sixth, seventh, and eighth grade middle school science students. The population of the classroom is comprised of twenty-seven students: four sixth grade, eleven seventh grade, and twelve eighth grade. Seventeen of the students are female the other ten are male. Of the female students eight are Caucasian, three are African American, and seven are mixed ethnicity. Of the male students, five are Caucasian, one is African American, and three are mixed ethnicity.

From the lens of the teacher, this group of students were observed as they participated in voice-on activities that emphasized prior knowledge, vocabulary acquisition and gameplay. Also, a review of the following student documents occurred throughout the study: pre-assessments, summative assessments, projects, writing samples, and answers recorded during and after non-digital gameplay.

To better understand how to prepare for the MCA's in middle school science, The *Voice-On Activities Guide For Sixth Grade Science* will be implemented in its entirety during the 2018-19 school year.

In lesson one of each unit are questions and strategies used to elicit prior knowledge and pique student interest in the topic. The importance of eliciting prior knowledge is key to building new constructs. Prior knowledge is the combined knowledge a student brings to the school environment, which includes explicit, tacit, metacognitive, and conceptual knowledge (Dochy and Alexander, 1995).

Also included in the guide are ten vocabulary lists with voice-on strategies to facilitate retention of the terms and definitions. The importance of vocabulary acquisition cannot be understated. Scientists utilize specific terminology to write and speak about their findings. It is this use of terminology that helps students make sense of science and the world around them (Dawes, 2004).

Each activity in the curriculum guide emphasizes collaboration and listening skills. To address equity and create a rich learning experience, guidelines for arranging students into groups according to gender, cultures, and varying levels of abilities are offered. It is important to give each student an opportunity to experience a wide range of personalities and perspectives.

Finally, at the conclusion of each lesson, non-digital games are used to reinforce the lesson's vocabulary targets. Engaging students with science games can improve retention and increase the construct of knowledge (Coil, Ettinger, and Eisen, 2017). Although each unit has its own one-of-a-kind game, each game can be adapted for use in any unit by simply changing the vocabulary terms and definitions.

Assessments. The curriculum guide uses voice-on activities as a tool for formative assessments. Eliciting prior knowledge, discussing new vocabulary, and collaborating during non-digital gameplay allows teachers to gain a sense of their students' abilities. Routinely monitoring students by peaking over their shoulder or asking them open-ended questions, teachers can adjust instruction based off work samples and student responses. Although the curriculum guide was created with formative assessment in mind, printable pre-assessments and summative assessments embedded within each unit allow teachers to collect data while students demonstrate mastery of the material.

Staff Involved

Once per month the school's science, technology, engineering, and math (STEM) committee meets to discuss collaborative learning opportunities, objectives, goals, and teaching strategies. Members of the committee include the K-5 classroom teachers and the middle school math and science teachers. Each of these staff members will participate in a professional development meeting, which includes a PowerPoint presentation highlighting the importance of the curriculum and the classroom activities outlined in the curriculum guide. Although the curriculum is designed for sixth grade science students, the meeting will provide evidence regarding prior knowledge, vocabulary acquisition, and gameplay as principled strategies to enhance voice-on activities in the classroom. One of the many goals of the STEM staff will be to increase scores on the MCA's. Although the sixth-grade students will not be tested on the science MCA's until 2020, the goal is to continue developing the curriculum guide to align with the seventh and eighth science standards. At that time, the name of the document will change from Voice-On Activities Curriculum Guide For Sixth Grade Science to Voice-On Activities Curriculum Guide For Middle School Science. The completion of this guide will occur summer of 2018.

Summary

In chapter one I addressed my past and current employment and what led me to the question: *Which strategies enhance voice-on activities in middle school science?* In chapter two a review of the literature explored the strategies used in the Voice-On Activities Curriculum Guide For Sixth Grade Science. In this chapter a discussion of the school's demographics, testing results, the methods of research, and how the curriculum guide was and will continue to be used to prepare students for the Minnesota Comprehensive Assessment. Finally, a discussion about how strategies of prior knowledge, vocabulary acquisition, and non-digital gameplay are used as formative assessments. In chapter four a discussion of the curriculum design and the potential implications will seek to answers the question: *Which strategies enhance voice-on activities in middle school science?*

Chapter Four

Conclusion

Background For Writing

I remember sitting in classrooms where teachers did all the talking and students recorded notes. In all my time, I cannot remember comparing or studying the notes with my friends, we just sat and scribbled. Years after high school, I began working in collaborative environments and began noticing how others spoke. While the folks in the front office spoke with eloquence able to string together intelligent sentences one after another, the folks in the trench struggled and used word fillers to complete the simplest of phrases. I belonged to this latter group. Clearly the folks in the office, with their silver tongues, were exposed to rich oral environments at school or home. It was no wonder they were in charge operations and communications and not the heavy lifting. I was envious. If I planned to crawl out of the trench and advance my career, I needed to improve my vocabulary. I had to play catch up.

Today, after many years of working to improve my science vocabulary, I feel confident speaking in the classroom, yet outside the classroom, I feel uneasy weighing in on unfamiliar topics. Often times when I find myself engaged in a conversation too deep for my skills, I vacillate between active listening and searching for words to insert into the conversation. In my mind's eye, I can see the words but they are used so infrequently that they are difficult to coax out. I attribute this struggle of word searching to a lack of preparedness and a lack of knowledge. It is the desperate feeling of being unprepared and without knowledge that I want my students to avoid.

As a middle school science teacher, my ears are always tuned-in listening and assessing my students' level of scientific conversations. I want them to be confident when speaking about topics related to science. To improve my students', use of scientific language, I researched the following question: *Which strategies enhance voice-on activities in middle school science?*

In this chapter, I will review the literature as it pertains to prior knowledge, vocabulary acquisition, gameplay, and discuss the pros and cons of the curriculum guide as a tool to improve science literacy and the use of academic language through voice-on activities.

What I Learned

When I set out to write this capstone, I knew there was likely no definition for voice-on activities since I recently coined the phrase in 2016. Used as a classroom tool to manage behavior and improve academic language, the term voice-on activities is used to categorize conversations, discourse, discussions, turn to your partner, and other actions that integrate student voices as a means to create meaningful learning opportunities. After doing a web search for voice-on activities, it was confirmed that there was no definition; however, there was a great deal of information that emphasized oral strategies as a way to engage students and improve knowledge in science. While reviewing the literature, I focused my attention on three topics: prior knowledge, vocabulary acquisition, and non-digital games. According to the literature review, each of the strategies is proven to enhance voice-on activities.

Although plenty of literature on prior knowledge and vocabulary acquisition existed, there was limited research on non-digital games to improve science literacy. Although there are numerous articles related to digital games and their effectiveness for improved educational outcomes, my goal was to find evidence for non-digital games to support teachers working in low-resource classrooms. My opposition to digital games is that they are too expensive and players often play in isolation whereas, non-digital games encourage face-to-face voice-on interactions among students.

Revisit The Literature

Even though I am rewarded each day by my students' rich scientific conversations, up until this point in my practice I neglected to do any research regarding the effectiveness of voice-on activities. It was only until I was tasked with the capstone, that I set out to uncover the strategies to improve my practice.

The Voice-On Activities Curriculum Guide For Sixth Grade Science relies heavily on vocabulary with the primarily focus being on non-digital gameplay. The games in the guide aim to facilitate rich conversations among students while acquiring vocabulary extracted from the sixth grade Minnesota science standards. The vocabulary found within each unit acts as a foundation to create a classroom environment filled with substantive conversations.

Influential Literature. The review of prior knowledge was the most influential literature for my practice and my project. Although the project is rich with vocabulary and uses gameplay as a way to reinforce concepts, without the foundation of prior knowledge imbedded into each lesson, students will struggle synthesizing new information. Teachers that take time to elicit prior knowledge before starting a lesson can promote meaningful learning opportunities for each student, (Campbell, 2008). Using images, music, and even smells can ignite students' memories that will enhance engagement during voice-on activities. As an added benefit to eliciting prior knowledge in my classroom, I find that I spend less time teaching and more time listening for misconceptions.

New Connections

After implementing the first pre-assessment in the curriculum guide, my twenty-seven middle school science students scored only 54%. After implementing voice-on activities that included a project and presentation, group work, brainstorming, and gameplay to reinforce vocabulary, these same students increased their scores on a summative assessment to 94%. Although these numbers are great, the rich conversations that occur inside the classroom during voice-on activities inspire me the most.

Policy Implications

At a STEM meeting in spring of 2018, the staff at my school discussed strategies to improve student skills in math and science. To my surprise, other staff members were using games in their classrooms as a means to reinforce content knowledge. At the upcoming 2018-yearend STEM meeting, I plan to share the curriculum guide and my results. Since members of the STEM committee have already implemented non-digital games into their curriculum, a possible policy to emerge from the yearend meeting is as follows: *To ensure students are science literate, our staff will place an emphasis on voice-on activities using prior knowledge, vocabulary acquisition, and gameplay as strategies for success.*

Implementing such a policy might encourage committee members to modify their curriculum or use the voice-on activities guide as a template to design their own. Strategies and games shared among colleagues during this process will strengthen our relationships, direct our focus, and enhance student achievement. If each member of the STEM committee commits to creating a curriculum guide, it will make our jobs, our mission, and our students' experience much richer.

The Project

The purpose of the sixth-grade voice-on activities curriculum guide is to enhance students' science literacy and use of academic language by eliciting prior knowledge, introducing new vocabulary, and using gameplay as strategies to reinforce learning.

The Voice-On Activities Curriculum Guide For Sixth Grade Science contains ten units with five lessons each. Each unit is a modified version of a backward design lesson template derived from the Understanding by Design Professional Development Workbook 2004. Units are arranged starting with the *Established Goals*, which state the targeted Minnesota academic standard for sixth grade science. The language used in the *Established Goals*, *Understandings*, *Students Will Know*, and the *Students Will Be Able To* sections of each unit are derived from the sixth-grade frameworks of the Minnesota STEM Teacher Center. The *Essential Questions* section lists the driving questions that teachers will want to ask and reinforce throughout the unit. The *Performance Tasks* section lists the pre-assessments, projects, labs, and the summative assessments to be given during each unit while the *Other Evidence* section includes formative assessments to monitor student questions, questions to elicit prior knowledge, vocabulary lists, games, projects, labs and website recommendations.

For ease of use, the ten units are arranged using the scientific acronym for visible colors: ROYGBIV (Red, Orange, Yellow, Green, Blue, Indigo, and Violet). Each unit header is coded in red, lessons are coded in orange, pre-assessments yellow, vocabulary lists green, games are blue, labs are indigo, and summative assessments are coded in violet.

Each game listed under a blue header is designed to encourage competition and promote vocabulary acquisition and retention. Some of the games in this document are modified versions of famous game shows while others are originals designs. Questions for each game are derived from the vocabulary terms found within the sixth-grade resource section of the Minnesota State Standards.

In addition, prior knowledge questions, pre-assessments, formative assessments, summative assessments, along with vocabulary lists, flashcards/game cards, and non-digital games are included. In lesson one of each new unit students are asked a series of questions to elicit prior knowledge and lure them into the learning fold. From a constructivist point of view, using the questions and other strategies outlined in the guide uncover preexisting constructs that aid in the construction of new knowledge.

Afterwards, pre-assessments are distributed to check for individual proficiency and findings are used to better guide instruction. Following the pre-assessment, the unit vocabulary is distributed and groups are arranged into varying abilities and ethnicities to create a rich learning experience during voice-on activities.

Finally, at the conclusion of each unit non-digital game strategies are used to reinforce the lessons vocabulary targets. Although each unit has its own one-of-a-kind game, each game can be adapted for use in any unit by simply changing the vocabulary terms and definitions.

Project Limitations

The project is loaded with scientific vocabulary. Because of this, English learners, students below grade level for reading, and perhaps students with delayed speech may require supports to benefit from the guide. The vocabulary in the guide is not recommended as a replacement for science content; rather, it is used to enhance student outcomes and voice-on activities.

Another limitation to the curriculum guide is that teachers will need to establish their own classroom management plan. Since students will engage in voice-on activities, teachers must be confident in their role as leader striking a balance between classroom control and student fun. Because adrenaline will be pumping, the race games are placed near the end of the guide so teachers have time to adjust their management strategies and students have time to conform to expectations. Also during the race games students will be required to run. Since some students may have physical limitations, teachers will need to consider safe alternatives.

Lastly, teachers will need access to a copy machine. To increase longevity of the flashcards/game cards teachers should use a cardstock when possible. If budgetary limitations exist, teachers can print just one set of vocabulary flashcards/game cards on traditional copy paper. Since there are over one hundred terms available, teachers should print only those terms they need, and then divide them into envelopes before distributing the flashcards to groups and individuals.

Recommendations. Teachers should focus on prior knowledge to uncover what students know before investing too much time into lessons and gameplay. Introducing gameplay prior to building scientific knowledge would be counterproductive.

In addition, teachers should understand that prior knowledge might look different from one culture to the next. Oftentimes, varying ethnicities experience different ways of knowing. It is this experience and knowledge that should be used to enrich discussions and drive new investigations.

Finally, while eliciting prior knowledge, students will sometimes veer off topic. Do not be discouraged. Encouraging students to share their experiences is the ultimate goal of voice-on activities; however, if nonsense persists, with a calm confidence teachers must regain control by redirecting the conversation. Voice-on activities are a win-win for the profession. While teachers' develop classroom management skills and learn about the needs of their students, students engage in scientific conversation and learn from each other

Results. Although the Voice-On Activities Curriculum Guide For Sixth Grade Science is designed with formative assessments in mind, pre-assessments and summative assessments have been added so teachers can collect data and monitor student growth. After implementing the lessons with successful results, I firmly believe the curriculum guide will benefit other teachers outside my school community.

How The Project Benefits The Profession. Teachers in low-resource classrooms can use the curriculum to enhance voice-on activities, nurture equitable environments, and prepare all students for careers in science without breaking their budget.

The guide with its standardized curriculum also benefits administrators who experience high turnover rates and first year science teachers who are in need of an easy to follow resource. Having a printable document with non-digital games, vocabulary terms, flashcards/ game cards, and assessments will make the jobs of the aforementioned professionals less taxing. Finally, the voice-on activities inside the curriculum guide build equity inside the classroom and prepare all students for careers in science.

Future Research

If I were to continue my research, I would consider the following question: *How to use non-digital gameplay to reduce the achievement gap in middle school science?* My experience and attitude toward gameplay is that it transcends cultural barriers. Everyone in my classroom loves gameplay and everyone wants to win. I am fortunate to teach a multicultural classroom where all my students enjoy playing together and using the flashcards/game cards to test and improve their knowledge. By using formative assessments, I can verify that my students have made enormous gains. When I first introduced the games in this guide, the initial rounds often took ten minutes to play, but after increased repetition and studying, the time to complete each game was reduced to fewer than five minutes.

Summary

The need to engage students in voice-on activities is paramount to their academic success and career readiness. Students need opportunities to use scientific language to gain a deeper understanding of scientific concepts. By implementing voice-on activities, teachers can measure student learning through formative assessments rather than relying on summative assessments alone. Regardless of a student's career path, using the strategies in this guide will give students a solid foundation for which to build new knowledge in future scientific disciplines.

Conclusion

No more are the days of silent traditional classrooms—students need a to be heard—they need to engage in voice-on activities. As a teacher and a scholar, I learned that prior knowledge, vocabulary acquisition, and gameplay are essential strategies to promote science literacy through the use of voice-on activities. After implementing the Voice-On Curriculum Guide For Sixth Grade Science during my middle school science class, I am convinced that my students will be better prepared for the rigors of high school, college, and career opportunities.

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